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# BIOASSESSMENT AND HABITAT EVALUATION

# OF

# STREAMS NEAR ELLISTON, MONTANA

Revision and Modification
of a Report Submitted in March, 1999

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REPORT PREPARED FOR
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July 1999

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## INTRODUCTION

Benthic assemblages are aptly applied to aquatic bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Their long lives, complex life cycles and limited mobility mean that there is ample time for these benthic organisms to respond to cumulative effects of environmental perturbations. Multimetric approaches to bioassessment use attributes of the assemblage in an integrated way to measure overall biotic condition.

The additive multimetric approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as "... an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition." (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment. (Fore et al.1995).

This report summarizes benthic macroinvertebrate and habitat data collected in August 1998 from streams near Elliston, Montana, using a multimetric method, an adaptation of the U.S. EPA's Rapid Bioassessment Protocols (RBP III) (Plafkin et al. 1989). The data is intended to provide baseline bioassessments against which future assessments can be compared.

## METHODS

Benthic macroinvertebrate sampling was performed by personnel of the Montana Department of Environmental Quality (MT DEQ) on August 12, 13, 18 and 19. Samples were collected from reaches in four streams. For quality assurance purposes, sampling at three sites was replicated to provide an estimate of the variability inherent in the sampling and assessment methods. The twelve samples that comprise this study are identified below.

- Dog Creek, Reach 1 Site 1 (two replicates)
- Dog Creek, Reach 1 Site 2 (two replicates)
- Dog Creek, Reach 2 Site 1
- Dog Creek, Reach 2 Site 2
- Dog Creek, Reach 3 Site 1
- Elliston Creek, Reach 1 Site 1
- Elliston Creek, Reach 2 Site 1
- Woodson Gulch, Reach 2 Site 1
- Spotted Dog Creek, Reach 1 Site 1 (two replicates)

In addition to sample collection, habitat quality was visually evaluated at some sites and reported by means of the habitat assessment protocol recommended by Bukantis (1998).

Sample processing and data analyses were contracted to Rhithron Biological Associates. In the laboratory, the Rapid Bioassessment Protocol III (RBPIII) (Plafkin et al. 1989) was used to obtain subsamples of 300 (+/- 10%) organisms from each sample. Community structure, function and sensitivity to impact were characterized for each

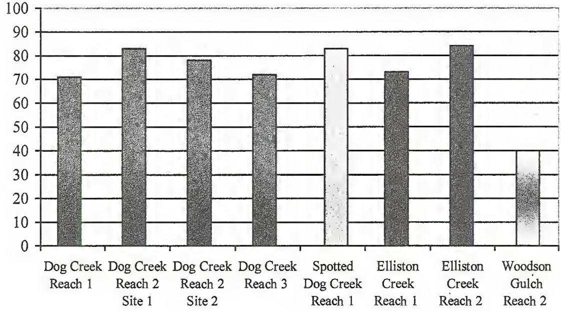
subsample using three methods, two which are prescribed by MT DEQ, and a third method, the results of which are set out in an addendum to this report. First, data were evaluated using the mountain ecoregions reference. In this approach, benthic communities were compared with reference criteria established by MT DEQ for streams of all three montane ecoregions of the State. The mountain ecoregions reference uses an integration of seven metrics to characterize biotic health. In the second approach, a composite internal reference for the streams of this study was assembled, and data from each stream is compared to that internal reference. The composite internal reference approach implies that the reference value for each of the seven metrics was established based on the performance of that metric in the communities of the Dog/Elliston/Woodson Gulch/Spotted Dog drainages alone. Total, integrated metric scores were obtained for each method by summing scores for all metrics, and a "use support" designation was derived from the total bioassessment score based upon criteria described in Table 5.

## RESULTS

### *Habitat assessment*

Figure 1 compares habitat assessment results for all sites studied. Breakdown of total scores into the nine evaluated parameters is presented in Tables 1 and 2.

**Figure 1.** Total habitat assessment scores for Dog Creek, Elliston Creek and Woodson Gulch sites. August, 1998.



Marginal habitat conditions were noted at the site in Woodson Gulch, which received the lowest total habitat assessment score of the sites studied. Numerous factors were perceived to contribute to degraded conditions here, including moderately unstable

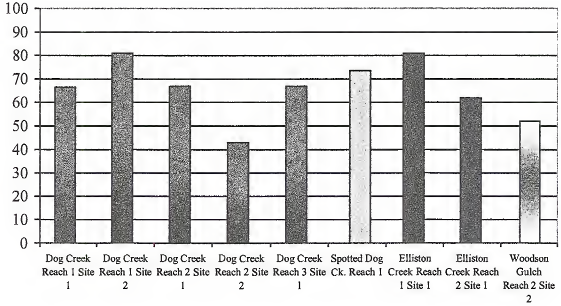
banks largely lacking in vegetation. Moderately severe deposition of sediment and small granitic gravels was noted, and has resulted in monotonous substrate and lack of instream habitat diversity. Embeddedness was reported to be severe. Old mining disruption combined with more recent bulldozer work on the streambank resulted in moderately severe channel alteration.

Habitat conditions scored more favorably at the upper site on Elliston Creek (Reach 1), and at three of the four sites sampled on Dog Creek (Reach 1, Reach 2 Site 2 and Reach 3). Each of these sites was rated sub-optimal. At the upper Elliston Creek site, moderately severe sediment deposition was noted, and a corresponding severe degradation of the benthic substrate, which was dominated by deposited gravels and silt. Moderate embeddedness of larger substrate particles was reported and water was turbid here.

Sub-optimal habitat conditions at the uppermost Dog Creek sites were perceived to be due to mild streambank erosion with resultant instream sedimentation. Some disruption of streambank vegetation was also noted. Mild to moderate streambank erosion was reported at the downstream site in Reach 2 of Dog Creek. Mild channel alteration was noted at the lowest site on Dog Creek, in Reach 3. This was associated with mild to moderate limitations on riparian zone width due to the presence of a railroad bed adjacent to the creek at this site.

Optimal habitat conditions were assessed at the downstream reach of Elliston Creek (Reach 2) and at the lower site in Reach 2 of Dog Creek (Reach 2 Site 1). Even so, mild sediment deposition was reported at the Elliston Creek site, and channel alteration was noted at the Dog Creek site. Habitat conditions in the evaluated reach of Spotted Dog Creek were also rated optimal, but sediment in substrate interstices was noted here as well.

**Figure 2.** Total bioassessment score based on the mountain ecoregions reference. Dog Creek, Spotted Dog Creek, Elliston Creek, and Woodson Gulch. August, 1998. For replicated samples, mean values are given.



### *Bioassessment*

Macroinvertebrate taxa lists, metric results and other information for each sample are given in the Appendix.

*The Mountain Ecoregions reference*

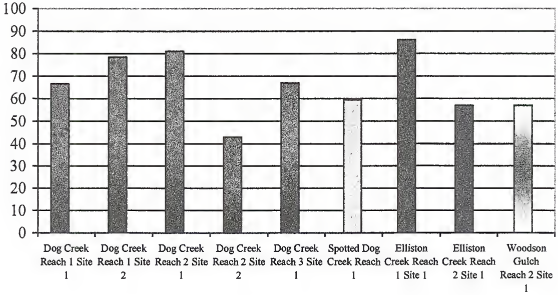
Figure 2 compares total bioassessment scores from integrated and summed metrics using the ecoregional reference scoring criteria. Table 3 summarizes this method and criteria. Breakdown of scores for each metric is presented in Tables 5 and 6.

Compared to the ecoregion reference, the biotic health of the upper Elliston Creek site (Reach 3) was considered to fully support its use designation, with a bioassessment score that was 81% of the maximum. Site 2 in Reach 2 of Dog Creek received the lowest bioassessment score of the seven sites, 43% of maximum. In addition to the upper Elliston Creek site (Reach 1), Dog Creek Reach 1 Site 2 was also classed as fully supporting its use designation. All other sites were partially supporting.

*The composite internal reference*

When compared only with each other by means of the composite internal reference, the streams in this study generally receive scores similar to those they received when compared to streams across the mountain ecoregions. As before, the highest total bioassessment score was assigned to the uppermost Elliston Creek site (Reach 1 Site 1), which was considered fully-supporting its use classification and the lowest score was

**Figure 3.** Total bioassessment score based on internal reference. Dog Creek, Spotted Dog Creek, Elliston Creek, and Woodson Gulch. August, 1998. For replicated samples, mean values are given.



assigned to the upper site in Reach 2 of Dog Creek (Reach 2 Site 2), which was considered partially use-supporting. The lower site in Reach 2 of Dog Creek scored better than the upper site (Reach 1 Site 2) when the composite internal reference approach was used. The assessment at Woodson Gulch improved somewhat when the stream is compared only to the others in this study, but the assessment at Spotted Dog Creek deteriorated compared to its performance against the ecoregion as a whole. Where the comparison with the mountain ecoregions reference produced two sites with full use-support designations, only the uppermost Elliston Creek site (Reach 1) attained a full use-support designation when the streams were compared only to one another. All other reaches, including Reach 1 Site 2 of Dog Creek, were rated as partially supporting of their uses.

### *Replicates*

For quality assurance purposes, three sets of replicate samples were collected at Sites 1 and 2 of Reach 1 of Dog Creek, and at the Spotted Dog Creek site. Comparing replicates to one another can provide an estimate of the variability in total bioassessment scores for all of the sites studied in the project, given the sampling and assessment methods used. Comparing total bioassessment scores for the paired replicates gave a mean coefficient of variability ($V$) of 8% when the mountain ecoregions reference was used. The composite internal reference bioassessment method yielded a mean coefficient of 14%. These values for $V$ suggest moderate variability in bioassessment scores when these methods are used. A comparison of individual metrics calculated for the three sets of replicated samples can be found in the Appendix. Comparison of the variability of total bioassessment scores for each pair of replicates considered separately can be found in the Addendum at the end of this report, where the revised bioassessment method and its variability is discussed.

A comparison of the taxonomic similarity between paired replicates reveals moderate similarity between replicates collected at all three sites. At Dog Creek Reach 1 Site 1, samples shared 19 taxa in common (45% of taxa collected at the site), at Dog Creek Reach 1 Site 2, samples shared 27 taxa (52% of taxa collected at the site). Replicates collected from Spotted Dog Creek had the lowest similarity of taxonomic composition of the three pairs: of 42 taxa collected at the site, replicates shared only 16 (38%).

### *Macroinvertebrate communities*

Among the seven macroinvertebrate assemblages in this study, the greatest similarity between communities was found between Site 2 in the uppermost reach (Reach 1) of Dog Creek and the uppermost reach of Elliston Creek. These sites shared 27 taxa (47% of all taxa collected at the two sites) in common to both. Average similarity between sites in this study was 26.5%, expressed as the number of taxa in common between two sites as a percent of the total number of taxa collected at the two sites. Not surprisingly, adjacent sites in Dog Creek and in Elliston Creek had greater than average similarities with one another. Community similarities are summarized in Figure 4, which compiles the number of taxa shared between benthic assemblages and the percentage of shared taxa for all possible pairs of assemblages.

**Figure 4.** Similarity of benthic communities, expressed as the number of taxa in common between two communities. Numbers in parentheses are the percentages of shared taxa. To compare replicated samples with unreplicated samples, total taxonomic composition of the pair of replicates was regarded as a single sample. Dog Creek, Elliston Creek, Spotted Dog Creek, and Woodson Gulch, August 1998.

| | **Dog Creek Reach 1 Site 2** | **Dog Creek Reach 2 Site 1** | **Dog Creek Reach 2 Site 2** | **Dog Creek Reach 3 Site 1** | **Elliston Creek Reach 1 Site 1** | **Elliston Creek Reach 2 Site 1** | **Woodsn Gulch Reach 2 Site 2** | **Spotted Dog Creek Reach 1** |
|---|---|---|---|---|---|---|---|---|
| **Dog Creek Reach 1 Site 1** | 18 (25) | 10 (16) | 9 (16) | 10 (15) | 12 (20) | 11 (18) | 14 (25) | 20 (34) |
| **Dog Creek Reach 1 Site 2** | | 23 (37) | 14 (24) | 20 (30) | 27 (47) | 21 (34) | 18 (29) | 17 (24) |
| **Dog Creek Reach 2 Site 1** | | | 13 (30) | 16 (31) | 12 (24) | 13 (28) | 7 (13) | 12 (20) |
| **Dog Creek Reach 2 Site 2** | | | | 19 (41) | 18 (39) | 18 (44) | 12 (26) | 10 (19) |
| **Dog Creek Reach 3 Site 1** | | | | | 17 (31) | 14 (27) | 11 (19) | 12 (18) |
| **Elliston Creek Reach 1 Site 1** | | | | | | 20 (43) | 12 (23) | 11 (18) |
| **Elliston Creek Reach 2 Site 1** | | | | | | | 9 (17) | 17 (32) |
| **Woodson Gulch Reach 2** | | | | | | | | 9 (16) |

Ten sensitive taxa were present in the paired samples collected at the uppermost Dog Creek site (Reach 1 Site 1) including three very intolerant species of nemourid stoneflies: *Visoka cataractae, Zapada columbiana* and *Zapada fridgida*. The last of these is collected in bioassessment studies in Montana only infrequently, and its presence

suggests that habitat and water quality were excellent in this reach. The caddisfly *Cryptochia* sp. was relatively abundant at this site, indicating good retention of woody debris and heavy forest canopy. Relatively poor performance of this site when compared to ecoregion or composite internal references is due to moderately low EPT richness scores. The low scores may be attributable to the comparatively few mayfly taxa collected in the paired samples. On the other hand, high plecoptera and trichoptera taxa richness was noted here. These findings may be due to small size of the stream at this location, or to sampling or subsampling error. Analysis of the taxonomic composition of the communities present at the uppermost Dog Creek site suggests that neither the ecoregion reference method nor the composite internal reference method reflect the actual biotic condition of this site.

Reach 1 Site 2 of Dog Creek had the highest taxa richness of the seven benthic assemblages studied. The community as a whole, however is relatively tolerant (average value for biotic index = 3.45) compared to the expected community of a montane stream. Only two sensitive taxa, the mayfly *Drunella grandis* and the caddisfly *Parapsyche elsis* were present in low abundances in the paired samples from this site. Elevated water temperatures, or organic and/or nutrient pollution may account for these observations. Large numbers of the shredding caddisfly *Micrasema* sp., which comprised 26% of the sampled assemblage suggested adequate canopy cover, but the presence of the baetid *Centroptilum* sp. and the snail *Physella* sp. suggests that water temperatures may be elevated at this site. The EPT richness of 18 also suggests slight impairment.

In Reach 2 of Dog Creek, the differences in the two sampled assemblages was striking. At the lower site in Reach 2 (Reach 2 Site 2), 60% of the assemblage was comprised of the caddisfly *Brachycentrus occidentalis*. Such an overwhelming abundance of this filterer-scraper suggests relatively warm water temperatures, and organic inputs, perhaps from cattle or from streambank erosion, though the effects of beaver dam outflows cannot be excluded. The habitat assessment, indicating optimal habitat at this site, supports the hypothesis that water quality impairment here may be involved in the moderately impaired biotic health indicated by the bioassessment score. Low EPT richness (11) at this site suggests this also, especially considering that only four mayfly taxa were collected at this site. Contrarily, the biotic index score at this site (2.99) was quite low. The benthic community at the upper site (Reach 2 Site 1), where moderately severe embeddedness of substrate particles and fine silt were noted, was dominated by the sediment-tolerant elmids *Optioservus* sp., *Cleptelmis* sp., and *Zaitzevia* sp. which together made up 47% of the sampled organisms. There were twelve fewer taxa collected from the lower site than from the upper site, including eight fewer EPT taxa.

In the lowest sampled reach of Dog Creek (Reach 3 Site 1), a high biotic index score (4.30) suggests that organic and/or nutrient pollution affects the benthic community at this site. In addition, sediment-tolerant elmids in four taxa comprise 32% of the sampled assemblage at this site, corresponding with the observations of moderately severe embeddedness of substrate particles. The sediment-tolerant mayfly *Tricorythodes minutus* was also found here. Although EPT richness was the highest among Dog Creek sites, these taxa included the tolerant mayfly as well as two tolerant caddisfly taxa, *Ochrotrichia* sp. and *Oecetis* sp. Tolerant taxa comprised nearly 38% of the organisms collected here.

Twelve sensitive taxa were collected in the paired samples from Spotted Dog Creek. These included the peltoperlid stonefly *Yoraperla brevis* and the leuctrid stonefly *Paraleuctra* sp., both cold stenotherms. Other taxa collected here that are only found in cold waters include the midge *Diamesa* sp., the mayfly *Baetis bicaudatus,* and the limnephilid caddisfly *Dicosmoecus atripes*. A total of 28 EPT taxa were collected from Spotted Dog Creek, the highest EPT taxa richness of any site in the study. These observations, together with the very low mean biotic index score (1.94), suggest excellent biotic health at the Spotted Dog Creek site. The relatively poor bioassessment scores of this site seem to be the result of the low abundance of scraper and shredder taxa; both replicates received low scores for this metric. However, scraper and shredder taxa richness for these samples was high. Also contributing to lower than expected bioassessment scores given the taxonomic composition of the samples was the low abundance of organisms collected in one of the replicates; only 126 organisms were collected. This low abundance could be due to habitat degradation, however, the second replicate collected at the same site contained many more organisms.

The uppermost site on Elliston Creek (Reach 1 Site 1) had the highest total bioassessment score of any site when the ecoregional reference was used. (When the composite internal reference method was used, the uppermost site on Dog Creek shared the highest score with this site.) Despite this, moderately severe sediment deposition and substrate embeddedness was perceived at this site and reported in the habitat assessment. The sediment-tolerant elmid *Optioservus* sp. was the most abundant organism collected here, and this taxon, together with three other elmids, comprised 32% of the sampled assemblage. Still, taxa richness and EPT richness were high, suggesting that habitat diversity was not severely compromised.

The lower Elliston Creek site (Reach 2 Site 1) also had high taxa richness and EPT richness, seeming to correspond well with the observation of optimal habitat quality. However, these numbers may suggest that organic and/or nutrient enrichment may be present; the observation is supported by the relatively high biotic index value (4.36) and by the low relative abundance of mayfly, stonefly and caddisfly individuals (EPT percent = 30). More than 50% of the sampled assemblage was comprised of tolerant organisms.

In Woodson Gulch, marginal habitat quality is combined with slight-to-moderate impairment of biotic health, as indicated by these bioassessment methods. The habitat assessment reports problems with monotonous benthic substrate dominated by granitic sand, severe embededness of substrate and other evidence of degraded habitat. The benthic community, however, is not so severely limited as the habitat assessment would suggest. Five sensitive taxa, including the leuctrid stonefly *Despaxia augusta* , and the predatory-filtering caddisfly *Parapsyche elsis* were collected here, giving strong evidence that habitat diversity is still at least partly intact in Woodson Gulch. The abundant presence of the triclad *Polycelis coronata*, which comprised 16% of the sampled assemblage suggests that groundwater influences the stream at the sampling site. Some impairment, however, may be suggested by the low EPT richness (15). Though the field data is not specific on the sampling method, effort, or duration, there may have been a low macroinvertebrate density at this site as well; only 638 organisms were present in the sample. The number of organisms estimated in samples from Elliston Creek and Dog Creek ranged from 1965 to 8700. Low macroinvertebrate density strongly suggests habitat degradation, but small stream size may be an explanation as well.

**Figure 5.** Relationships between total habitat assessment scores and total bioassessment scores. Dog Creek, Elliston Creek and Woodson Gulch. August 1998. Individual replicates are indicated by identical symbols. Note the overlap of two replicates from different sites with identical habitat and bioassessment scores, indicated by a blue triangle (Dog Creek Reach 1 Site 1) within a triangle outline (Dog Creek Reach 1 Site 2).

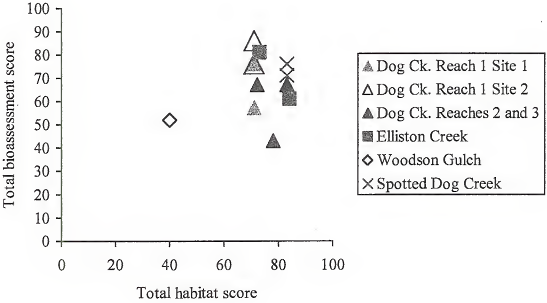


Figure 5 summarizes the relationships between total habitat assessment scores and total bioassessment scores (based on the ecoregion reference) for all sites in this study. All but two of the sites exhibit the relationship expected when habitat degradation is the main negative determinant of biotic health. One site on Elliston Creek, the lower site (Reach 2, Site 1) and one site on Dog Creek, the upper site in Reach 2 (Reach 2 Site 2) fall below a line representing correspondence between habitat quality and bioassessment score. (One of the two replicate samples from Reach 1 Site 1 of Dog Creek also falls within this area.) This position on the graph is a strong suggestion of a further contribution of water quality impairment on the impacts to biotic health of the benthic communities.

## CONCLUSIONS

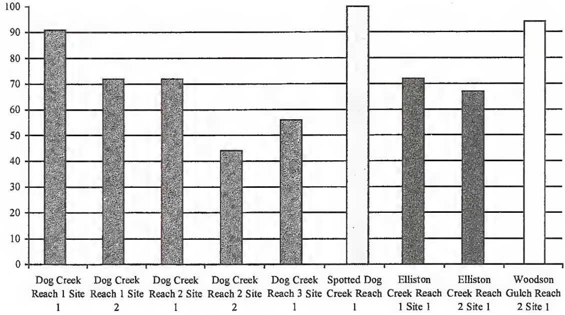
- Macroinvertebrate communities and habitat assessments alike suggest that sedimentation impairs the benthic assemblages in Dog Creek below Reach 1 Site 1. Poor streambank stability, roads, and cattle impacts have been implicated as sources of the sediment. Higher water temperatures than expected for montane benthos is also suggested by the macroinvertebrate data.

- Water quality impairment at the upper site in Dog Creek's Reach 2 (Reach 2 Site 2) is suggested by the combination of optimal habitat and moderate impairment of biotic health.
- Benthic assemblages collected from Elliston Creek suggest that impairment to biotic health in this stream may also be due primarily to sediment deposition.
- In Woodson Gulch, the composition of the benthic community suggests that habitat diversity persists to some degree, despite the report of marginal habitat quality. Abundant sensitive taxa indicate good biotic health.
- Samples from Spotted Dog Creek contained many sensitive taxa, including a variety of cold stenotherms. Biotic health and habitat quality at the sampled site appear to be excellent.
- Metals contamination does not seem to be a significant threat to biotic health at any site in this study. The metals tolerance index values ranged from 2.03 to 3.54.

## ADDENDUM: *Application of a revised bioassessment method to the Elliston-area data*

Figure 6 compares bioassessment scores for sites using a revised bioassessment method devised by Bollman (1998). This method uses a battery of six metrics and was evaluated for sensitivity to impairment, relevance to habitat and water quality degradation and replicability for a set of samples collected in the Montana Valleys and Foothill Prairies (MVFP) Ecoregion. While the Elliston-area streams in this study do not fall within the MVFP Ecoregion, application of the method to another montane system (Miles et al. 1999) has suggested its applicability to these systems as well.

**Figure 6.** Total bioassessment score based on a revised bioassessment method. Dog Creek, Spotted Dog Creek, Elliston Creek, and Woodson Gulch. August, 1998. For replicated samples, mean values are given.



Sites with abundant sensitive taxa and other clear taxonomic-based indications of good biotic health were assigned appropriately higher bioassessment scores by the revised method. Dog Creek sites which seem more impaired by sediment, possible nutrient and/or organic pollution and higher water temperatures, such as Reach 2 Site 2 and Reach 3 Site 1, received the lowest bioassessment scores. Sites with moderate impairment from sediment, pollutants or water temperature, such as the Elliston Creek sites and Reach 1 Site 2 and Reach 2 Site 1 of Dog Creek, received intermediate scores.

Replication of samples provides a means to estimate the adequacy of the sampling and subsampling methods in representing the benthic assemblages present at a site. It can also provide an opportunity to evaluate the replicability of the bioassessment method, or its "precision", defined here as the variability of bioassessment scores assigned to sample replicates, which presumably were taken from locations with nearly identical impairment. Figure 7 compares the coefficient of variability (*V*) calculated for bioassessment scores

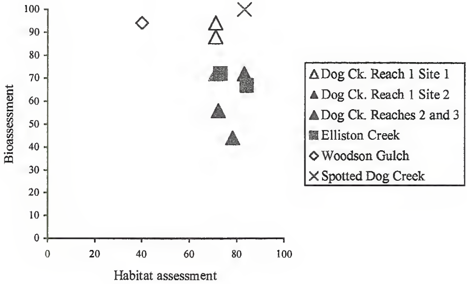
using each of the three bioassessment methods presented in this study, for each pair of replicated samples, and the mean value for *V* for each method. Close similarity in scores (low value for *V*) between a set of replicated samples suggests, but does not absolutely assure, that both the sampling and assessment methods adequately represent the benthic community, and thus the biotic health of a site.

**Figure 7.** Coeeficient of variability (*V*) and mean values for *V* for bioassessment scores calculated for replicated samples from Elliston-area streams using three different bioassessment methods.

| replicates | Mountain Ecoregions reference | Composite internal reference | Revised bioassessment method |
|---|---|---|---|
| **Dog Creek Reach 1 Site 1** | 14.3 | 21.8 | 3.0 |
| **Dog Creek Reach 1 Site 2** | 6.2 | 16.2 | 0 |
| **Spotted Dog Creek** | 3.4 | 4.2 | 0 |
| **Mean V** | 8.0 | 14.1 | 1.0 |

Figure 5 summarizes the relationships between total habitat assessment scores and total bioassessment scores (based on the revised assessment method) for all sites in this study. The position of the symbols for Reach 2 Site 2 and Reach 3 Site 1 on Dog Creek strongly suggest the strong influence of water quality impairments on the biotic health at these sites. Dog Creek's Reach 1 Site 2 and Reach 2 Site 1, and the two sites on Elliston Creek also show some water quality degradation. The Spotted Dog Creek site, and the replicated samples from Dog Creek Reach 1 Site 1 are examples of sites with good habitat and excellent water quality. The position of the site in Woodson Gulch suggests that excellent water quality may mitigate the effect of degraded habitat.

**Figure 8.** Relationships between total habitat assessment scores and total bioassessment scores. Dog Creek, Elliston Creek and Woodson Gulch. August 1998. Individual replicates are indicated by identical symbols.



## TABLES

**Table 1. Stream and riparian habitat assessment: Dog Creek, August 12 and 13, 1998.**

| Max. possible score | Location: | Dog Creek Reach 1 | Dog Creek Reach 2, Site1 | Dog Creek Reach 2, Site 2 | Dog Creek Reach 3, Site 1 |
|---|---|---|---|---|---|
| | Parameter | | | | |
| 10 | riffle development | 9 | 8 | 8 | 9 |
| 10 | substrate development | 5 | 7 | 8 | 8 |
| 20 | embeddedness | 8 | 10 | 19 | 10 |
| 20 | channel alteration | 16 | 14 | 15 | 12 |
| 20 | sediment deposition | 11 | 18 | 18 | 18 |
| 20 | flow status | 20 | 19 | 18 | 16 |
| 10/10 | bank stability (right/left) | 6 / 7 | 10 / 7 | 8 / 3 | 8 / 8 |
| 10/10 | bank vegetative cover (right/left) | 7 / 7 | 9 / 9 | 6 / 6 | 9 / 6 |
| 10/10 | riparian width (right/left) | 7 / 10 | 10 / 10 | 10 / 6 | 8 / 3 |
| 160 | TOTAL: | 113 | 133 | 125 | 115 |
| PERCENT OF MAXIMUM: | | 71 | 83 | 78 | 72 |
| CONDITION[1]: | | SUB-OPTIMAL | OPTIMAL | SUB-OPTIMAL | SUB-OPTIMAL |

1. Condition categories: Optimal > 81% of maximum score; Sub-optimal 75 - 56%; Marginal 49 - 29%; Poor <23%.

**Table 2. Stream and riparian habitat assessment: Elliston Creek and Woodson Gulch, August 18 and 19, 1998.**

| Max. possible score | Location: | Spotted Dog Creek Reach 1 | Elliston Creek Reach 1, Site 1 | Elliston Creek Reach 2, Site 1 | Woodson Gulch Reach 2, Site 1 |
|---|---|---|---|---|---|
| | Parameter | | | | |
| 10 | riffle development | 7 | 9 | 10 | 2 |
| 10 | substrate development | 6 | 2 | 8 | 2 |
| 20 | embeddedness | 13 | 6 | 10 | 3 |
| 20 | channel alteration | 19 | 20 | 20 | 7 |
| 20 | sediment deposition | 15 | 6 | 13 | 5 |
| 20 | flow status | 18 | 18 | 15 | 18 |
| 10/10 | bank stability (right/left) | 9 / 9 | 9 / 9 | 9 / 10 | 5 / 5 |
| 10/10 | bank vegetative cover (right/left) | 9 / 9 | 10 / 10 | 10 / 10 | 5 / 3 |
| 10/10 | riparian width (right/left) | 9 / 10 | 8 / 10 | 10 / 9 | 2 / 7 |
| 160 | TOTAL: | 133 | 117 | 134 | 64 |
| PERCENT OF MAXIMUM: | | 83 | 73 | 84 | 40 |
| CONDITION[1]: | | OPTIMAL | SUB-OPTIMAL | OPTIMAL | MARGINAL |

1. Condition categories: Optimal > 81% of maximum score; Sub-optimal 75 - 56%; Marginal 49 - 29%; Poor <23%.

**Table 3. Mountain ecoregions metrics and scoring criteria (from Bukantis, 1998).**

| | Scoring Criteria | | | |
|---|---|---|---|---|
| metric | 3 | 2 | 1 | 0 |
| Taxa richness | >28 | 28 - 24 | 24 - 19 | <19 |
| EPT richness | >19 | 19 - 17 | 17 - 15 | <15 |
| Biotic index | <3 | 3 - 4 | 4 - 5 | >5 |
| % dominant taxon | <25 | 25 - 35 | 35 - 45 | >45 |
| %Collector(g+ff) | <60 | 60 - 70 | 70 - 80 | >80 |
| % Scraper +Shredder | >55 | 55 - 40 | 40 - 25 | <25 |
| % EPT | >70 | 70 - 55 | 55 - 40 | <40 |

**Table 4. Internal reference values and criteria for assigning scores to metrics based on percent comparability to reference values (from McGuire 1995, with modification):**

| | Dog Creek, Elliston Creek and Woodson Gulch | Scoring Criteria | | | | |
|---|---|---|---|---|---|---|
| metric | reference, 1998 | 3 | 2 | 1 | 0 | * |
| Taxa richness | 43 | > 80% | 80-60% | 60-40% | < 40% | a |
| EPT richness | 22 | > 85% | 85-70% | 70-50% | < 50% | a |
| Biotic index | 2.99 | > 90% | 90-80% | 80-70% | < 70% | b |
| % dominant taxon | 15 | > 60% | 60-45% | 45-30% | < 30% | b |
| %Collector(g+ff) | 26 | > 90% | 90-80% | 80-65% | < 65% | b |
| % Scraper +Shredder | 65 | > 80% | 80-60% | 60-40% | < 40% | a |
| % EPT | 71 | > 75% | 75-50% | 50-25% | < 25% | a |

[1.] 1998 internal reference values are the "best" appropriate values among those calculated.

* a = score is ratio of study site to reference x 100.

* b = score is ratio of reference to study site x 100.

**Table 5. Criteria for the assignment of support classifications / standards violation thresholds (from Bukantis, 1997)**

| % Comparability to reference | Use support |
|---|---|
| >75 | Full support--standards not violated |
| 25-75 | Partial support--moderate impairment--standards violated |
| <25 | Non-support--severe impairment--standards violated |

**Table 6. Metric values, percentage of reference, and bioassessments, based on composite internal reference, for Dog Creek sites. August, 1998.**

| metric | Dog Creek Reach 1 Site 1 Rep 1 | Dog Creek Reach 1 Site 1 Rep 2 | Dog Creek Reach 1 Site 2 Rep 1 | Dog Creek Reach 1 Site 2 Rep 2 | Dog Creek Reach 2 Site 1 | Dog Creek Reach 2 Site 2 | Dog Creek Reach 3 Site 1 |
|---|---|---|---|---|---|---|---|
| Taxa richness | 30 | 33 | 38 | 43 | 35 | 23 | 38 |
| EPT richness | 19 | 15 | 19 | 18 | 19 | 11 | 21 |
| Biotic index | 2.64 | 3.31 | 2.90 | 3.99 | 4.06 | 2.99 | 4.30 |
| % dominant taxon | 24 | 15 | 35 | 17 | 33 | 60 | 19 |
| % Collector (g+ff) | 26 | 46 | 30 | 50 | 36 | 73 | 58 |
| % Scrapers + Shredders | 34 | 24 | 65 | 44 | 57 | 26 | 39 |
| % EPT | 47 | 36 | 60 | 50 | 35 | 70 | 37 |
| % of reference | | | | | | | |
| Taxa richness | 70 | 77 | 88 | 100 | 81 | 53 | 88 |
| EPT richness | 86 | 68 | 86 | 81 | 86 | 50 | 95 |
| Biotic index | 100 | 90 | 100 | 75 | 74 | 100 | 70 |
| % dominant taxon | 63 | 100 | 43 | 88 | 45 | 25 | 79 |
| % Collector (g+ff) | 100 | 57 | 87 | 52 | 72 | 36 | 45 |
| % Scrapers + Shredders | 52 | 37 | 100 | 68 | 88 | 40 | 60 |
| % EPT | 67 | 51 | 86 | 71 | 50 | 100 | 53 |
| metric score | | | | | | | |
| Taxa richness | 2 | 2 | 3 | 3 | 3 | 1 | 3 |
| EPT richness | 3 | 1 | 3 | 2 | 3 | 1 | 3 |
| Biotic index | 3 | 3 | 3 | 1 | 1 | 3 | 1 |
| % dominant taxon | 3 | 3 | 1 | 3 | 2 | 0 | 3 |
| % Collector (g+ff) | 3 | 0 | 2 | 0 | 1 | 0 | 0 |
| % Scrapers + Shredders | 1 | 0 | 3 | 2 | 3 | 1 | 2 |
| % EPT | 2 | 2 | 3 | 2 | 2 | 3 | 2 |
| total score (max = 21) | 17 | 11 | 18 | 15 | 17 | 9 | 14 |
| % reference | 81 | 52 | 86 | 71 | 81 | 43 | 67 |
| use support* | FULL | PART | FULL | PART | FULL | PART | PART |

*See Table 5 for use support designation criteria.

**Table 7. Metric values, percentage of reference, and bioassessments, based on composite internal reference, for Spotted Dog Creek, Elliston Creek, and Woodson Gulch. August, 1998.**

| metric | Spotted Dog Ck. Reach 1 Site 1 Rep.1 | Spotted Dog Ck. Reach 1 Site 1 Rep.2 | Elliston Creek Reach 1 Site 1 | Elliston Creek Reach 2 Site 1 | Woodson Gulch Reach 2 Site 1 |
|---|---|---|---|---|---|
| Taxa richness | 24 | 34 | 35 | 31 | 32 |
| EPT richness | 18 | 22 | 19 | 17 | 15 |
| Biotic index | 1.98 | 1.89 | 3.72 | 4.36 | 4.82 |
| % dominant taxon | 32 | 29 | 18 | 31 | 19 |
| % Collector (g+ff) | 48 | 48 | 48 | 42 | 41 |
| % Scrapers + Shredders | 29 | 24 | 50 | 52 | 23 |
| % EPT | 60 | 62 | 65 | 30 | 36 |
| % of reference | | | | | |
| Taxa richness | 56 | 79 | 81 | 72 | 74 |
| EPT richness | 81 | 100 | 86 | 77 | 68 |
| Biotic index | 100 | 100 | 80 | 69 | 62 |
| % dominant taxon | 47 | 52 | 83 | 48 | 79 |
| % Collector (g+ff) | 54 | 54 | 54 | 62 | 63 |
| % Scrapers + Shredders | 45 | 37 | 77 | 80 | 35 |
| % EPT | 86 | 86 | 93 | 43 | 51 |
| metric score | | | | | |
| Taxa richness | 1 | 2 | 3 | 2 | 2 |
| EPT richness | 2 | 3 | 3 | 2 | 1 |
| Biotic index | 3 | 3 | 2 | 0 | 0 |
| % dominant taxon | 2 | 2 | 3 | 2 | 3 |
| % Collector (g+ff) | 0 | 0 | 0 | 0 | 0 |
| % Scrapers + Shredders | 1 | 0 | 2 | 3 | 0 |
| % EPT | 3 | 3 | 3 | 1 | 2 |
| total score (max = 21) | 12 | 13 | 16 | 10 | 8 |
| % reference | 57 | 62 | 76 | 48 | 38 |
| use support* | PART | PART | FULL | PART | PART |

*See Table 5 for use support designation criteria.

**Table 8. Metric scoring and bioassessments based on mountain ecoregions reference. Dog Creek. August, 1998.**

| *metric* | *Dog Creek Reach 1 Site 1 Rep. 1* | *Dog Creek Reach 1 Site 1 Rep. 2* | *Dog Creek Reach 1 Site 2 Rep. 1* | *Dog Creek Reach 1 Site 2 Rep. 2* | *Dog Creek Reach 2 Site 1* | *Dog Creek Reach 2 Site 2* | *Dog Creek Reach 3 Site 1* |
|---|---|---|---|---|---|---|---|
| taxa richness | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| EPT richness | 2 | 1 | 2 | 2 | 2 | 0 | 3 |
| biotic index | 3 | 2 | 3 | 2 | 1 | 3 | 1 |
| % dominant taxon | 3 | 3 | 2 | 3 | 2 | 0 | 3 |
| % collectors (g + ff) | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| % scraper+shredder | 1 | 0 | 3 | 2 | 3 | 1 | 1 |
| % EPT | 1 | 0 | 2 | 1 | 0 | 3 | 0 |
| Total score (max.=21) | 16 | 12 | 18 | 16 | 14 | 9 | 14 |
| percent of maximum | 76 | 57 | 86 | 76 | 67 | 43 | 67 |
| use support * | FULL | PART | FULL | FULL | PART | PART | PART |

* See Table 2a. FULL = full support, PARTIAL = partial support, NON! = non-support.

**Table 9. Metric scoring and bioassessments based on mountain ecoregions reference. Spotted Dog Creek, Elliston Creek, and Woodson Gulch. August, 1998.**

| *metric* | *Spotted Dog Creek Reach 1 Site1 Rep. 1* | *Spotted Dog Creek Reach 1 Site1 Rep. 2* | *Elliston Creek Reach 1 Site 1* | *Elliston Creek Reach 2 Site 1* | *Woodson Gulch* |
|---|---|---|---|---|---|
| taxa richness | 2 | 3 | 3 | 3 | 3 |
| EPT richness | 2 | 3 | 2 | 2 | 1 |
| biotic index | 3 | 3 | 2 | 1 | 1 |
| % dominant taxon | 2 | 2 | 3 | 2 | 3 |
| % collectors (g + ff) | 3 | 3 | 3 | 3 | 3 |
| % scraper+shredder | 1 | 0 | 2 | 2 | 0 |
| % EPT | 2 | 2 | 2 | 0 | 0 |
| Total score (max.=21) | 15 | 16 | 17 | 13 | 11 |
| percent of maximum | 71 | 76 | 81 | 62 | 52 |
| use support [*] | PART | FULL | FULL | PART | PART |

[*] See Table 2a. FULL = full support, PARTIAL = partial support, NON! = non-support.

# APPENDIX

**Aquatic Macroinvertebrate Taxonomic Data**
Dog Creek, Reach 1, Site 1. Sample 1. August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 80 | 24.39 | 4 | PR |
| Ostracoda | 7 | 2.13 | 8 | CG |
| Acari | 1 | 0.30 | 5 | PA |
| TOTAL: MISC. TAXA | 88 | 26.83 | | |
| Baetis flavistriga | 6 | 1.83 | 5 | CG |
| Drunella coloradensis | 1 | 0.30 | 0 | CG |
| Serratella tibialis | 5 | 1.52 | 2 | CG |
| Nixe | 2 | 0.61 | 4 | SC |
| TOTAL: EPHEMEROPTERA | 14 | 4.27 | | |
| Sweltsa | 7 | 2.13 | 0 | PR |
| Amphinemura | 32 | 9.76 | 2 | SH |
| Zapada columbiana | 31 | 9.45 | 2 | SH |
| Zapada frigida | 1 | 0.30 | 1 | SH |
| Doroneuria | 5 | 1.52 | 0 | PR |
| Megarcys | 3 | 0.91 | 1 | PR |
| TOTAL: PLECOPTERA | 79 | 24.09 | | |
| Micrasema | 12 | 3.66 | 1 | SH |
| Lepidostoma | 1 | 0.30 | 1 | SH |
| Cryptochia | 4 | 1.22 | 1 | SH |
| Psychoglypha subborealis | 1 | 0.30 | 2 | CG |
| Dolophilodes | 1 | 0.30 | 0 | CF |
| Rhyacophila Betteni Gr. | 1 | 0.30 | 0 | PR |
| Rhyacophila Brunnea Gr. | 5 | 1.52 | 2 | PR |
| Rhyacophila narvae | 9 | 2.74 | 0 | PR |
| Neothremma alicia | 28 | 8.54 | 1 | SC |
| TOTAL: TRICHOPTERA | 62 | 18.90 | | |
| Heterlimnius | 47 | 14.33 | 3 | CG |
| Hydrophilidae: Ametor | 7 | 2.13 | 5 | PR |
| TOTAL: COLEOPTERA | 54 | 16.46 | | |
| Ceratopogonidae | 2 | 0.61 | 6 | PR |
| Dixa | 1 | 0.30 | 4 | CG |
| Glutops | 10 | 3.05 | 1 | PR |
| TOTAL: DIPTERA | 13 | 3.96 | | |
| Eukiefferiella Brehmi Gr. | 1 | 0.30 | 8 | CG |
| Micropsectra | 8 | 2.44 | 4 | CG |
| Pagastia | 9 | 2.74 | 1 | CG |
| TOTAL: CHIRONOMIDAE | 18 | 5.49 | | |
| GRAND TOTAL | 328 | 100.00 | | |

**Aquatic Macroinvertebrate Taxonomic Data**
Dog Creek, Reach 1, Site 1. Sample 2. August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 48 | 14.76 | 4 | PR |
| Oligochaeta: Enchytraeidae | 2 | 0.60 | 10 | CG |
| Sphaeriidae | 4 | 1.20 | 8 | CF |
| Ostracoda | 44 | 13.55 | 8 | CG |
| Acari | 5 | 1.51 | 5 | PA |
| TOTAL: MISC. TAXA | 103 | 31.63 | | |
| Baetis | 6 | 1.81 | 5 | CG |
| Drunella coloradensis | 1 | 0.30 | 0 | CG |
| Ameletus | 1 | 0.30 | 0 | CG |
| TOTAL: EPHEMEROPTERA | 8 | 2.41 | | |
| Chloroperlidae | 9 | 2.71 | 1 | PR |
| Amphinemura | 20 | 6.02 | 2 | SH |
| Visoka cataractae | 7 | 2.11 | 0 | SH |
| Zapada columbiana | 32 | 9.64 | 2 | SH |
| Doroneuria | 1 | 0.30 | 0 | PR |
| TOTAL: PLECOPTERA | 69 | 20.78 | | |
| Micrasema | 1 | 0.30 | 1 | SH |
| Cryptochia | 2 | 0.60 | 1 | SH |
| Dolophilodes | 7 | 2.11 | 0 | CF |
| Rhyacophila Betteni Gr. | 1 | 0.30 | 0 | PR |
| Rhyacophila Brunnea Gr. | 6 | 1.81 | 2 | PR |
| Rhyacophila narvae | 13 | 3.92 | 0 | PR |
| Neothremma alicia | 14 | 4.22 | 1 | SC |
| TOTAL: TRICHOPTERA | 44 | 13.25 | | |
| Heterlimnius | 30 | 9.04 | 3 | CG |
| Hydrophilidae | 5 | 1.51 | 5 | PR |
| TOTAL: COLEOPTERA | 35 | 10.54 | | |
| Glutops | 6 | 1.81 | 1 | PR |
| Dicranota | 1 | 0.30 | 3 | PR |
| Limnophila | 1 | 0.30 | 3 | MH |
| Tipula | 2 | 0.60 | 4 | SH |
| TOTAL: DIPTERA | 10 | 3.01 | | |
| Brillia | 3 | 0.90 | 4 | SH |
| Eukiefferiella Gracei Gr. | 12 | 3.61 | 4 | CG |
| Micropsectra | 13 | 3.92 | 4 | CG |
| Nanocladius | 1 | 0.30 | 3 | CG |
| Pagastia | 29 | 8.73 | 1 | CG |
| Thienemannimyia | 1 | 0.30 | 5 | PR |
| Tvetenia Bavarica Gr. | 2 | 0.60 | 5 | CG |
| TOTAL: CHIRONOMIDAE | 61 | 18.37 | | |
| GRAND TOTAL | 330 | 100.00 | | |

**Aquatic Macroinvertebrate Data:**

| Dog Creek Reach 1 Site 1 | Sample 1 | Sample 2 |
|---|---|---|
| Percent of sample used | 70 | 17 |
| Subsample size | 328 | 330 |
| | | |
| Percent EPT | 47 | 36 |
| Taxa richness | 30 | 33 |
| EPT richness | 19 | 15 |
| Biotic Index | 2.64 | 3.31 |
| Percent dominant taxon | 24.39 | 14.76 |
| Percent dominance of five dominant taxa | 66.47 | 55.72 |
| Percent dominance of ten dominant taxa | 81.10 | 77.41 |
| Percent collectors (gatherers plus filterers) | 26.49 | 46.07 |
| Percent scrapers plus shredders | 33.84 | 24.39 |
| Percent Hydropsychinae of Trichoptera | 00 | 00 |
| Metals tolerance index | 2.67 | 3.30 |
| Shannon H (log2) | 3.79 | 4.13 |
| Evenness | .77 | .82 |
| Brillouin H | 2.48 | 2.71 |
| Simpson D | .11 | .08 |
| EPT/Chironomidae | 8.61 | 1.98 |
| CTQa | 54.00 | 64.38 |
| Percent Baetidae of Ephemeroptera | 29 | 75 |
| | | |
| %Ephemeroptera | 4.26 | 2.41 |
| %Plecoptera | 24.07 | 20.78 |
| %Trichoptera | 18.88 | 13.26 |
| %Coleoptera | 16.46 | 10.55 |
| %Diptera | 3.96 | 3.01 |
| %Chironomidae | 5.48 | 18.36 |
| | | |
| Multivoltine | 32.32 | 44.95 |
| Univoltine | 46.19 | 39.68 |
| Semivoltine | 21.49 | 15.36 |

| Functional Feeding Groups | # taxa | % abundance | # taxa | % abundance |
|---|---|---|---|---|
| Predator | 10 | 39.30 | 10 | 27.72 |
| Collector-gatherer | 10 | 26.19 | 11 | 42.76 |
| Collector-filterer | 1 | .30 | 2 | 3.31 |
| Scraper | 2 | 9.15 | 1 | 4.22 |
| Shredder | 6 | 24.69 | 7 | 20.17 |
| | | | | |
| Estimated total number of organisms | | 469 | | 1941 |
| Estimated number collected per foot | | 17 | | 194 |
| Estimated number collected per minute | | 469 | | 1941 |

**Aquatic Macroinvertebrate Taxonomic Data**
Dog Creek, Reach 1, Site 2 Sample 1 August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 4 | 1.32 | 4 | PR |
| Oligochaeta: Tubificidae | 2 | 0.66 | 10 | CG |
| Sphaeriidae | 1 | 0.33 | 8 | CF |
| Physella | 2 | 0.66 | 8 | SC |
| TOTAL: MISC. TAXA | 9 | 2.96 | | |
| Baetis flavistriga | 3 | 0.99 | 5 | CG |
| Baetis tricaudatus | 12 | 3.95 | 4 | CG |
| Diphetor hageni | 5 | 1.64 | 5 | CG |
| Drunella grandis | 2 | 0.66 | 2 | CG |
| Serratella tibialis | 1 | 0.33 | 2 | CG |
| Cinygmula | 10 | 3.29 | 0 | SC |
| Nixe | 4 | 1.32 | 4 | SC |
| Paraleptophlebia | 1 | 0.33 | 1 | CG |
| Ameletus | 2 | 0.66 | 0 | CG |
| TOTAL: EPHEMEROPTERA | 40 | 13.16 | | |
| Amphinemura | 12 | 3.95 | 2 | SH |
| Hesperoperla pacifica | 3 | 0.99 | 1 | PR |
| Skwala | 1 | 0.33 | 3 | PR |
| TOTAL: PLECOPTERA | 16 | 5.26 | | |
| Sialis | 1 | 0.33 | 4 | PR |
| TOTAL: MEGALOPTERA | 1 | 0.33 | | |
| Arctopsyche grandis | 6 | 1.97 | 2 | CF |
| Parapsyche elsis | 1 | 0.33 | 0 | CF |
| Micrasema | 105 | 34.54 | 1 | SH |
| Agapetus | 5 | 1.64 | 0 | SC |
| Psychoglypha subborealis | 1 | 0.33 | 2 | CG |
| Wormaldia | 4 | 1.32 | 0 | CF |
| Rhyacophila Brunnea Gr. | 4 | 1.32 | 2 | PR |
| TOTAL: TRICHOPTERA | 126 | 41.45 | | |
| Cleptelmis addenda | 1 | 0.33 | 4 | CG |
| Optioservus | 39 | 12.83 | 5 | SC |
| Zaitzevia | 7 | 2.30 | 4 | CG |
| TOTAL: COLEOPTERA | 47 | 15.46 | | |
| Ceratopogonidae | 1 | 0.33 | 6 | PR |
| Simulium | 20 | 6.58 | 5 | CF |
| Dicranota | 1 | 0.33 | 3 | PR |
| TOTAL: DIPTERA | 22 | 7.24 | | |
| Brillia | 2 | 0.66 | 4 | SH |
| Cricotopus Nostococladius | 19 | 6.25 | 6 | SH |
| Cryptochironomus | 1 | 0.33 | 8 | CG |
| Eukiefferiella Gracei Gr. | 13 | 4.28 | 4 | CG |
| Micropsectra | 2 | 0.66 | 4 | CG |
| Pagastia | 1 | 0.33 | 1 | CG |
| Rheocricotopus | 2 | 0.66 | 4 | CG |
| Tvetenia Bavarica Gr. | 3 | 0.99 | 5 | CG |
| TOTAL: CHIRONOMIDAE | 43 | 14.14 | | |
| GRAND TOTAL | 304 | 100.00 | | |

**Aquatic Macroinvertebrate Taxonomic Data**

Dog Creek Reach 1 Site 2 Sample 2 August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 2 | 0.66 | 4 | PR |
| Nematoda | 1 | 0.33 | 5 | OM |
| Oligochaeta | 26 | 8.55 | 10 | CG |
| (Tubificidae 24, Haplotaxidae 1, Lumbriculidae 1) | | | | |
| Sphaeriidae | 8 | 2.63 | 8 | CF |
| Physella | 4 | 1.32 | 8 | SC |
| Acari | 3 | 0.99 | 5 | PA |
| TOTAL: MISC. TAXA | 44 | 14.47 | | |
| Baetis sp. | 13 | 4.28 | 5 | CG |
| Baetis tricaudatus | 5 | 1.64 | 4 | CG |
| Centroptilum | 7 | 2.30 | 2 | CG |
| Diphetor hageni | 7 | 2.30 | 5 | CG |
| Drunella grandis | 7 | 2.30 | 2 | CG |
| Cinygmula | 2 | 0.66 | 0 | SC |
| Nixe criddlei | 7 | 2.30 | 4 | SC |
| Paraleptophlebia debilis | 15 | 4.93 | 1 | CG |
| Ameletus | 9 | 2.96 | 0 | CG |
| TOTAL: EPHEMEROPTERA | 72 | 23.68 | | |
| Sweltsa | 1 | 0.33 | 0 | PR |
| Amphinemura | 10 | 3.29 | 2 | SH |
| Zapada cinctipes | 1 | 0.33 | 3 | SH |
| Hesperoperla pacifica | 2 | 0.66 | 1 | PR |
| Skwala | 1 | 0.33 | 3 | PR |
| TOTAL: PLECOPTERA | 15 | 4.93 | | |
| Arctopsyche grandis | 6 | 1.97 | 2 | CF |
| Micrasema | 53 | 17.43 | 1 | SH |
| Apatania | 1 | 0.33 | 3 | SC |
| Rhyacophila Brunnea Gr. | 4 | 1.32 | 2 | PR |
| TOTAL: TRICHOPTERA | 64 | 21.05 | | |
| Cleptelmis | 11 | 3.62 | 4 | CG |
| Lara avara | 1 | 0.33 | 1 | SH |
| Narpus | 1 | 0.33 | 2 | SH |
| Optioservus | 34 | 11.18 | 5 | SC |
| TOTAL: COLEOPTERA | 47 | 15.46 | | |
| Ceratopogonidae | 1 | 0.33 | 6 | PR |
| Simulium | 4 | 1.32 | 5 | CF |
| Limnophila | 1 | 0.33 | 3 | MH |
| TOTAL: DIPTERA | 6 | 1.97 | | |
| Brillia | 2 | 0.66 | 4 | SH |
| Cricotopus Nostococladius | 19 | 6.25 | 6 | SH |
| Cryptochironomus | 2 | 0.66 | 8 | CG |
| Eukiefferiella Devonica Gr. | 1 | 0.33 | 8 | CG |
| Eukiefferiella Gracei Gr. | 3 | 0.99 | 4 | CG |
| Micropsectra | 6 | 1.97 | 4 | CG |
| Monopelopia | 2 | 0.66 | 6 | PR |
| Pagastia | 1 | 0.33 | 1 | CG |
| Polypedilum | 2 | 0.66 | 6 | CG |
| Rheocricotopus | 13 | 4.28 | 4 | CG |
| Stictochironomus | 2 | 0.66 | 5 | CG |
| Thienemanniella | 3 | 0.99 | 6 | CG |
| TOTAL: CHIRONOMIDAE | 56 | 18.42 | | |
| GRAND TOTAL | 304 | 100.00 | | |

**Aquatic Macroinvertebrate Data:**

| Dog Creek Reach 1 Site 2 | Sample 1 | Sample 2 |
|---|---|---|
| Percent of sample used | 10 | 39 |
| Subsample size | 304 | 304 |
| | | |
| Percent EPT | 50 | 60 |
| Taxa richness | 43 | 38 |
| EPT richness | 18 | 19 |
| Biotic Index | 3.99 | 2.90 |
| Percent dominant taxon | 17.43 | 34.54 |
| Percent dominance of five dominant taxa | 48.34 | 64.48 |
| Percent dominance of ten dominant taxa | 66.77 | 79.94 |
| Percent collectors (gatherers plus filterers) | 49.67 | 29.96 |
| Percent scrapers plus shredders | 44.41 | 65.14 |
| Percent Hydropsychinae of Trichoptera | 00 | 00 |
| Metals tolerance index | 3.18 | 3.25 |
| Shannon H (log2) | 4.52 | 3.76 |
| Evenness | .83 | 72 |
| Brillouin H | 2.92 | 2.43 |
| Simpson D | .07 | .15 |
| EPT/Chironomidae | 2.70 | 4.23 |
| CTQa | 75.00 | 65.76 |
| Percent Baetidae of Ephemeroptera | 44 | 50 |
| | | |
| %Ephemeroptera | 23.67 | 13.17 |
| %Plecoptera | 4.94 | 527 |
| %Trichoptera | 21.05 | 41.45 |
| %Coleoptera | 15.46 | 15.46 |
| %Diptera | 1.98 | 7.24 |
| %Chironomidae | 18.44 | 14.16 |
| | | |
| Multivoltine | 23.68 | 16.86 |
| Univoltine | 51.97 | 63.24 |
| Semivoltine | 24.34 | 19.90 |

| Functional Feeding Groups | # taxa | % abundance | # taxa | % abundance |
|---|---|---|---|---|
| Predator | 7 | 4.29 | 7 | 4.95 |
| Collector-gatherer | 18 | 43.75 | 17 | 19.43 |
| Collector-filterer | 3 | 5.92 | 5 | 10.53 |
| Scraper | 5 | 15.79 | 5 | 19.74 |
| Shredder | 7 | 28.62 | 4 | 45.40 |
| | | | | |
| Estimated total number of organisms | | 3040 | | 780 |
| Estimated number collected per foot | | 127 | | 32 |
| Estimated number collected per minute | | 3040 | | 780 |

**Aquatic Macroinvertebrate Taxonomic Data**
Dog Creek Reach 2 Site 1 August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 1 | 0.34 | 4 | PR |
| Oligochaeta<br>(Lumbriculidae 3, Tubificidae 1) | 4 | 1.35 | 10 | CG |
| Sphaeriidae | 4 | 1.35 | 8 | CF |
| TOTAL: MISC. TAXA | 9 | 3.03 | | |
| Baetis tricaudatus | 9 | 3.03 | 4 | CG |
| Diphetor hageni | 5 | 1.68 | 5 | CG |
| Drunella grandis | 3 | 1.01 | 2 | CG |
| Ephemerella inermis | 9 | 3.03 | 4 | SC |
| Serratella tibialis | 6 | 2.02 | 2 | CG |
| Cinygmula | 3 | 1.01 | 0 | SC |
| Nixe criddlei | 6 | 2.02 | 4 | SC |
| Ameletus | 3 | 1.01 | 0 | CG |
| Tricorythodes minutus | 1 | 0.34 | 4 | CG |
| TOTAL: EPHEMEROPTERA | 45 | 15.15 | | |
| Sweltsa | 4 | 1.35 | 0 | PR |
| Amphinemura | 1 | 0.34 | 2 | SH |
| Zapada cinctipes | 1 | 0.34 | 3 | SH |
| Skwala | 3 | 1.01 | 3 | PR |
| TOTAL: PLECOPTERA | 9 | 3.03 | | |
| Micrasema | 28 | 9.43 | 1 | SH |
| Agapetus | 1 | 0.34 | 0 | SC |
| Ochrotrichia | 2 | 0.67 | 4 | PH |
| Apatania | 14 | 4.71 | 3 | SC |
| Wormaldia | 1 | 0.34 | 0 | CF |
| Rhyacophila Brunnea Gr. | 3 | 1.01 | 2 | PR |
| TOTAL: TRICHOPTERA | 49 | 16.50 | | |
| Cleptelmis | 8 | 2.69 | 4 | CG |
| Optioservus | 97 | 32.66 | 5 | SC |
| Zaitzevia | 34 | 11.45 | 4 | CG |
| TOTAL: COLEOPTERA | 139 | 46.80 | | |
| Hexatoma | 6 | 2.02 | 2 | PR |
| TOTAL: DIPTERA | 6 | 2.02 | | |
| Cricotopus Nostococladius | 8 | 2.69 | 6 | SH |
| Microtendipes | 4 | 1.35 | 6 | CG |
| Orthocladius | 12 | 4.04 | 6 | CG |
| Pagastia | 1 | 0.34 | 1 | CG |
| Rheocricotopus | 2 | 0.67 | 4 | CG |
| Rheotanytarsus | 1 | 0.34 | 6 | CF |
| Sublettea | 3 | 1.01 | 4 | UN |
| Tanytarsus | 8 | 2.69 | 6 | CF |
| Thienemannimyia | 1 | 0.34 | 5 | PR |
| TOTAL: CHIRONOMIDAE | 40 | 13.47 | | |
| GRAND TOTAL | 297 | 100.00 | | |

**Aquatic Macroinvertebrate Data:** Dog Creek Reach 2 Site 1

| | |
|---|---|
| Percent of sample used | 8 |
| Subsample size | 297 |
| | |
| Percent EPT | 35 |
| Taxa richness | 35 |
| EPT richness | 19 |
| Biotic Index | 4.06 |
| Percent dominant taxon | 32.66 |
| Percent dominance of five dominant taxa | 62.29 |
| Percent dominance of ten dominant taxa | 76.42 |
| Percent collectors (gatherers plus filterers) | 35.70 |
| Percent scrapers plus shredders | 56.57 |
| Percent Hydropsychinae of Trichoptera | 00 |
| Metals tolerance index | 3.54 |
| Shannon H (log2) | 3.85 |
| Evenness | .75 |
| Brillouin H | 2.49 |
| Simpson D | .14 |
| EPT/Chironomidae | 2.58 |
| CTQa | 68.26 |
| Percent Baetidae of Ephemeroptera | 31 |
| | |
| %Ephemeroptera | 15.15 |
| %Plecoptera | 3.04 |
| %Trichoptera | 16.50 |
| %Coleoptera | 46.80 |
| %Diptera | 2.02 |
| %Chironomidae | 13.47 |
| | |
| Multivoltine | 14.48 |
| Univoltine | 36.87 |
| Semivoltine | 48.65 |

| Functional Feeding Groups | # taxa | % abundance |
|---|---|---|
| Predator | 6 | 6.07 |
| Collector-gatherer | 13 | 30.98 |
| Collector-filterer | 4 | 4.72 |
| Scraper | 4 | 43.77 |
| Shredder | 4 | 12.80 |

| | |
|---|---|
| Estimated total number of organisms | 3712 |
| Estimated number collected per foot | 77 |
| Estimated number collected per minute | 1856 |

**Aquatic Macroinvertebrate Taxonomic Data**

Dog Creek Reach 2 Site 2 August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Baetis tricaudatus | 4 | 1.15 | 4 | CG |
| Drunella grandis | 1 | 0.29 | 2 | CG |
| Serratella tibialis | 4 | 1.15 | 2 | CG |
| Nixe criddlei | 3 | 0.86 | 4 | SC |
| TOTAL: EPHEMEROPTERA | 12 | 3.45 | | |
| Claassenia sabulosa | 1 | 0.29 | 3 | PR |
| TOTAL: PLECOPTERA | 1 | 0.29 | | |
| Brachycentrus occidentalis | 198 | 59.77 | 2 | CF |
| Micrasema | 9 | 2.59 | 1 | SH |
| Glossosoma | 4 | 1.15 | 0 | SC |
| Hydropsyche | 3 | 0.86 | 5 | CF |
| Lepidostoma | 6 | 1.72 | 1 | SH |
| Rhyacophila Brunnea Gr. | 1 | 0.29 | 2 | PR |
| TOTAL: TRICHOPTERA | 221 | 66.38 | | |
| Cleptelmis | 1 | 0.29 | 4 | CG |
| Optioservus | 21 | 6.32 | 5 | SC |
| Zaitzevia | 14 | 4.31 | 4 | CG |
| TOTAL: COLEOPTERA | 36 | 10.92 | | |
| Antocha | 1 | 0.29 | 3 | CG |
| Hexatoma | 1 | 0.29 | 2 | PR |
| TOTAL: DIPTERA | 2 | 0.57 | | |
| Cricotopus | 5 | 1.44 | 7 | CG |
| Cricotopus Nostococladius | 40 | 13.22 | 6 | SH |
| Eukiefferiella Gracei Gr. | 2 | 0.57 | 4 | CG |
| Micropsectra | 4 | 1.15 | 4 | CG |
| Orthocladius | 5 | 1.44 | 6 | CG |
| Pagastia | 1 | 0.29 | 1 | CG |
| Tvetenia Bavarica Gr. | 1 | 0.29 | 5 | CG |
| TOTAL: CHIRONOMIDAE | 58 | 18.39 | | |
| GRAND TOTAL | 330 | 100.00 | | |

| **Aquatic Macroinvertebrate Data:** Dog Creek Reach 2 Site 2 | |
|---|---|
| Percent of sample used | 4 |
| Subsample size | 330 |
| | |
| Percent EPT | 70 |
| Taxa richness | 23 |
| EPT richness | 11 |
| Biotic Index | 2.99 |
| Percent dominant taxon | 59.77 |
| Percent dominance of five dominant taxa | 86.21 |
| Percent dominance of ten dominant taxa | 93.11 |
| Percent collectors (gatherers plus filterers) | 73.29 |
| Percent scrapers plus shredders | 25.86 |
| Percent Hydropsychinae of Trichoptera | 01 |
| Metals tolerance index | 3.46 |
| Shannon H (log2) | 2.34 |
| Evenness | .52 |
| Brillouin H | 1.53 |
| Simpson D | .38 |
| EPT/Chironomidae | 3.81 |
| CTQa | 66.00 |
| Percent Baetidae of Ephemeroptera | 33 |
| | |
| %Ephemeroptera | 3.45 |
| %Plecoptera | .29 |
| %Trichoptera | 66.38 |
| %Coleoptera | 10.92 |
| %Diptera | .58 |
| %Chironomidae | 18.40 |
| | |
| Multivoltine | 14.87 |
| Univoltine | 14.01 |
| Semivoltine | 71.12 |

| Functional Feeding Groups | # taxa | % abundance |
|---|---|---|
| Predator | 3 | .87 |
| Collector-gatherer | 12 | 12.66 |
| Collector-filterer | 2 | 60.63 |
| Scraper | 3 | 8.33 |
| Shredder | 3 | 17.53 |

| | |
|---|---|
| Estimated total number of organisms | 8700 |
| Estimated number collected per foot | 155 |
| Estimated number collected per minute | 4350 |

**Aquatic Macroinvertebrate Taxonomic Data**
Dog Creek Reach 3 Site 1 August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 1 | 0.30 | 4 | PR |
| Oligochaeta<br>(Enchytraeidae 8, Tubificidae 9) | 17 | 5.15 | 10 | CG |
| Sphaeriidae | 2 | 0.61 | 8 | CF |
| Gyraulus | 1 | 0.30 | 8 | SC |
| TOTAL: MISC. TAXA | 21 | 6.36 | | |
| Acentrella insignificans | 1 | 0.30 | 4 | CG |
| Baetis tricaudatus | 4 | 1.21 | 4 | CG |
| Diphetor hageni | 1 | 0.30 | 5 | CG |
| Attenella margarita | 17 | 5.15 | 3 | CG |
| Serratella tibialis | 1 | 0.30 | 2 | CG |
| Nixe criddlei | 18 | 5.45 | 4 | SC |
| Tricorythodes minutus | 3 | 0.91 | 4 | CG |
| TOTAL: EPHEMEROPTERA | 45 | 13.64 | | |
| Sweltsa | 1 | 0.30 | 0 | PR |
| Zapada cinctipes | 1 | 0.30 | 3 | SH |
| Hesperoperla pacifica | 1 | 0.30 | 1 | PR |
| Skwala | 2 | 0.61 | 3 | PR |
| Pteronarcella | 1 | 0.30 | 4 | SH |
| TOTAL: PLECOPTERA | 6 | 1.82 | | |
| Arctopsyche grandis | 1 | 0.30 | 2 | CF |
| Brachycentrus occidentalis | 32 | 9.70 | 2 | CF |
| Agapetus | 3 | 0.91 | 0 | SC |
| Glossosoma | 13 | 3.94 | 0 | SC |
| Hydropsyche | 6 | 1.82 | 5 | CF |
| Ochrotrichia | 1 | 0.30 | 4 | PH |
| Lepidostoma | 13 | 3.94 | 1 | SH |
| Oecetis | 1 | 0.30 | 8 | PR |
| Rhyacophila Brunnea Gr. | 1 | 0.30 | 2 | PR |
| TOTAL: TRICHOPTERA | 71 | 21.52 | | |
| Cleptelmis | 1 | 0.30 | 4 | CG |
| Heterlimnius | 2 | 0.61 | 3 | CG |
| Optioservus | 63 | 19.09 | 5 | SC |
| Zaitzevia | 38 | 11.52 | 4 | CG |
| TOTAL: COLEOPTERA | 104 | 31.52 | | |
| Ceratopogonidae | 1 | 0.30 | 6 | PR |
| TOTAL: DIPTERA | 1 | 0.30 | | |
| Cricotopus | 1 | 0.30 | 7 | CG |
| Cricotopus Nostococladius | 17 | 5.15 | 6 | SH |
| Cricotopus Trifascia Gr. | 1 | 0.30 | 6 | CG |
| Micropsectra | 23 | 6.97 | 4 | CG |
| Orthocladius | 32 | 9.70 | 6 | CG |
| Pagastia | 1 | 0.30 | 1 | CG |
| Polypedilum | 6 | 1.82 | 6 | CG |
| Sublettea | 1 | 0.30 | 4 | UN |
| TOTAL: CHIRONOMIDAE | 82 | 24.85 | | |
| GRAND TOTAL | 330 | 100.00 | | |

| **Aquatic Macroinvertebrate Data:** Dog Creek Reach 3 Site 1 | |
|---|---|
| Percent of sample used | 7 |
| Subsample size | 330 |
| | |
| Percent EPT | 37 |
| Taxa richness | 38 |
| EPT richness | 21 |
| Biotic Index | 4.30 |
| Percent dominant taxon | 19.09 |
| Percent dominance of five dominant taxa | 56.98 |
| Percent dominance of ten dominant taxa | 81.82 |
| Percent collectors (gatherers plus filterers) | 57.57 |
| Percent scrapers plus shredders | 39.38 |
| Percent Hydropsychinae of Trichoptera | 08 |
| Metals tolerance index | 3.38 |
| Shannon H (log2) | 4.02 |
| Evenness | .77 |
| Brillouin H | 2.62 |
| Simpson D | .09 |
| EPT/Chironomidae | 1.49 |
| CTQa | 72.63 |
| Percent Baetidae of Ephemeroptera | 13 |
| | |
| %Ephemeroptera | 13.62 |
| %Plecoptera | 1.81 |
| %Trichoptera | 21.51 |
| %Coleoptera | 31.52 |
| %Diptera | .30 |
| %Chironomidae | 24.84 |
| | |
| Multivoltine | 20.98 |
| Univoltine | 33.86 |
| Semivoltine | 45.15 |

| Functional Feeding Groups | # taxa | % abundance |
|---|---|---|
| Predator | 7 | 2.41 |
| Collector-gatherer | 16 | 45.14 |
| Collector-filterer | 4 | 12.43 |
| Scraper | 5 | 29.69 |
| Shredder | 4 | 9.69 |

| | |
|---|---|
| Estimated total number of organisms | 4714 |
| Estimated number collected per foot | 83 |
| Estimated number collected per minute | 2357 |

**Aquatic Macroinvertebrate Taxonomic Data**
Elliston Creek Reach 1 Site 1 August 1998

| Taxon | # | % | hbi | FFG |
|---|---|---|---|---|
| Oligochaeta : Lumbricidae 4 | 4 | 1.26 | 10 | CG |
| Sphaeriidae | 7 | 2.02 | 8 | CF |
| Acari | 1 | 0.27 | 5 | PA |
| TOTAL: MISC. TAXA | 12 | 3.53 | | |
| Baetis sp. | 18 | 5.54 | 5 | CG |
| Baetis tricaudatus | 8 | 2.52 | 4 | CG |
| Centroptilum | 1 | 0.27 | 2 | CG |
| Diphetor hageni | 7 | 2.27 | 5 | CG |
| Drunella grandis | 47 | 14.86 | 2 | CG |
| Serratella tibialis | 1 | 0.27 | 2 | CG |
| Cinygmula | 3 | 0.91 | 0 | SC |
| Nixe criddlei | 29 | 8.82 | 4 | SC |
| Paraleptophlebia heteronea | 4 | 1.01 | 1 | CG |
| Ameletus | 17 | 5.04 | 0 | CG |
| TOTAL: EPHEMEROPTERA | 135 | 41.31 | | |
| Amphinemura | 11 | 3.53 | 2 | SH |
| Zapada cinctipes | 2 | 0.50 | 3 | SH |
| Hesperoperla pacifica | 2 | 0.50 | 1 | PR |
| Skwala | 4 | 1.26 | 3 | PR |
| Pteronarcella | 3 | 0.76 | 4 | SH |
| TOTAL: PLECOPTERA | 22 | 6.55 | | |
| Arctopsyche grandis | 2 | 0.50 | 2 | CF |
| Micrasema | 1 | 0.27 | 1 | SH |
| Hydropsyche | 1 | 0.27 | 5 | CF |
| Apatania | 54 | 16.37 | 3 | SC |
| TOTAL: TRICHOPTERA | 58 | 17.38 | | |
| Cleptelmis | 3 | 1.01 | 4 | CG |
| Optioservus | 60 | 18.39 | 5 | SC |
| Zaitzevia | 10 | 3.02 | 4 | CG |
| TOTAL: COLEOPTERA | 73 | 22.42 | | |
| Ceratopogonidae | 1 | 0.27 | 6 | PR |
| Ptychoptera | 1 | 0.27 | 7 | CG |
| Simulium | 5 | 1.51 | 5 | CF |
| Limnophila | 1 | 0.27 | 3 | MH |
| TOTAL: DIPTERA | 8 | 2.27 | | |
| Brillia | 2 | 0.50 | 4 | SH |
| Eukiefferiella Devonica Gr. | 2 | 0.50 | 8 | CG |
| Eukiefferiella Gracei Gr. | 2 | 0.50 | 4 | CG |
| Eukiefferiella Pseudomontana Gr. | 3 | 1.01 | 8 | CG |
| Orthocladius | 11 | 3.78 | 6 | CG |
| Pagastia | 1 | 0.27 | 1 | CG |
| TOTAL: CHIRONOMIDAE | 21 | 6.55 | | |
| GRAND TOTAL | 329 | | | |

| **Aquatic Macroinvertebrate Data:** Elliston Creek Reach 1 Site 1 | |
|---|---|
| Percent of sample used | 8 |
| Subsample size | 329 |
| | |
| Percent EPT | 65 |
| Taxa richness | 35 |
| EPT richness | 19 |
| Biotic Index | 3.72 |
| Percent dominant taxon | 18.39 |
| Percent dominance of five dominant taxa | 63.98 |
| Percent dominance of ten dominant taxa | 81.87 |
| Percent collectors (gatherers plus filterers) | 47.60 |
| Percent scrapers plus shredders | 49.88 |
| Percent Hydropsychinae of Trichoptera | 01 |
| Metals tolerance index | 2.88 |
| Shannon H (log2) | 3.90 |
| Evenness | .76 |
| Brillouin H | 2.56 |
| Simpson D | .10 |
| EPT/Chironomidae | 9.96 |
| CTQa | 66.56 |
| Percent Baetidae of Ephemeroptera | 26 |
| | |
| %Ephemeroptera | 41.32 |
| %Plecoptera | 6.55 |
| %Trichoptera | 17.37 |
| %Coleoptera | 22.42 |
| %Diptera | 2.26 |
| %Chironomidae | 6.54 |
| | |
| Multivoltine | 13.16 |
| Univoltine | 61.02 |
| Semivoltine | 25.82 |

| Functional Feeding Groups | # taxa | % abundance |
|---|---|---|
| Predator | 3 | 2.01 |
| Collector-gatherer | 17 | 43.32 |
| Collector-filterer | 4 | 4.28 |
| Scraper | 4 | 44.34 |
| Shredder | 5 | 5.54 |

| | |
|---|---|
| Estimated total number of organisms | 4962 |
| Estimated number collected per foot | 207 |
| Estimated number collected per minute | 4962 |

**Aquatic Macroinvertebrate Taxonomic Data**

Elliston Creek Reach 2 Site 1 August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 1 | 0.30 | 4 | PR |
| Oligochaeta: Enchytraeidae | 27 | 8.08 | 10 | CG |
| Sphaeriidae | 2 | 0.60 | 8 | CF |
| TOTAL: MISC. TAXA | 30 | 8.98 | | |
| Baetis sp. | 1 | 0.30 | 5 | CG |
| Baetis tricaudatus | 18 | 5.39 | 4 | CG |
| Centroptilum | 1 | 0.30 | 2 | CG |
| Attenella margarita | 2 | 0.60 | 3 | CG |
| Drunella grandis | 7 | 2.10 | 2 | CG |
| Serratella tibialis | 4 | 1.20 | 2 | CG |
| Cinygmula | 1 | 0.30 | 0 | SC |
| Nixe criddlei | 5 | 1.50 | 4 | SC |
| Rhithrogena | 6 | 1.80 | 0 | SC |
| Ameletus | 8 | 2.40 | 0 | CG |
| TOTAL: EPHEMEROPTERA | 53 | 15.87 | | |
| Amphinemura | 3 | 0.90 | 2 | SH |
| Zapada cinctipes | 2 | 0.60 | 3 | SH |
| Doroneuria | 4 | 1.20 | 0 | PR |
| TOTAL: PLECOPTERA | 9 | 2.69 | | |
| Arctopsyche grandis | 4 | 1.20 | 2 | CF |
| Micrasema | 17 | 5.09 | 1 | SH |
| Glossosoma | 13 | 3.89 | 0 | SC |
| Apatania | 5 | 1.50 | 3 | SC |
| TOTAL: TRICHOPTERA | 39 | 11.68 | | |
| Cleptelmis | 1 | 0.30 | 4 | CG |
| Narpus | 1 | 0.30 | 2 | SH |
| Optioservus | 98 | 30.54 | 5 | SC |
| Zaitzevia | 41 | 12.28 | 4 | CG |
| TOTAL: COLEOPTERA | 141 | 43.41 | | |
| Ceratopogonidae | 7 | 2.10 | 6 | PR |
| Hexatoma | 6 | 1.80 | 2 | PR |
| TOTAL: DIPTERA | 13 | 3.89 | | |
| Constempellina | 1 | 0.30 | 4 | CG |
| Cricotopus Nostococladius | 20 | 5.99 | 6 | SH |
| Cricotopus Trifascia Gr. | 1 | 0.30 | 6 | CG |
| Eukiefferiella Gracei Gr. | 7 | 2.10 | 4 | CG |
| Orthocladius | 16 | 4.79 | 6 | CG |
| TOTAL: CHIRONOMIDAE | 45 | 13.47 | | |
| GRAND TOTAL | 330 | 100.00 | | |

**Aquatic Macroinvertebrate Data:** Elliston Creek Reach 2 Site 1

| | |
|---|---|
| Percent of sample used | 17 |
| Subsample size | 330 |
| | |
| Percent EPT | 30 |
| Taxa richness | 31 |
| EPT richness | 17 |
| Biotic Index | 4.36 |
| Percent dominant taxon | 30.54 |
| Percent dominance of five dominant taxa | 62.28 |
| Percent dominance of ten dominant taxa | 80.55 |
| Percent collectors (gatherers plus filterers) | 42.24 |
| Percent scrapers plus shredders | 52.41 |
| Percent Hydropsychinae of Trichoptera | 00 |
| Metals tolerance index | 3.48 |
| Shannon H (log2) | 3.76 |
| Evenness | .76 |
| Brillouin H | 2.46 |
| Simpson D | .13 |
| EPT/Chironomidae | 2.24 |
| CTQa | 63.29 |
| Percent Baetidae of Ephemeroptera | 38 |
| | |
| %Ephemeroptera | 15.89 |
| %Plecoptera | 2.70 |
| %Trichoptera | 11.68 |
| %Coleoptera | 43.42 |
| %Diptera | 3.90 |
| %Chironomidae | 13.48 |
| | |
| Multivoltine | 14.90 |
| Univoltine | 34.96 |
| Semivoltine | 50.15 |

| Functional Feeding Groups | # taxa | % abundance |
|---|---|---|
| Predator | 4 | 5.40 |
| Collector-gatherer | 14 | 40.44 |
| Collector-filterer | 2 | 1.80 |
| Scraper | 6 | 39.53 |
| Shredder | 5 | 12.88 |

| | |
|---|---|
| Estimated total number of organisms | 1965 |
| Estimated number collected per foot | 73 |
| Estimated number collected per minute | 1965 |

**Aquatic Macroinvertebrate Taxonomic Data**
Woodson Gulch Reach 2 Site 1 August 1998

| **Taxon** | # | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 51 | 15.68 | 4 | PR |
| Nematoda | 4 | 1.18 | 5 | OM |
| Oligochaeta : Tubificidae | 2 | 0.59 | 10 | CG |
| Sphaeriidae | 36 | 10.95 | 8 | CF |
| Ostracoda | 60 | 18.64 | 8 | CG |
| Acari | 2 | 0.59 | 5 | PA |
| TOTAL: MISC. TAXA | 155 | 47.63 | | |
| Baetis tricaudatus | 10 | 2.96 | 4 | CG |
| Drunella grandis | 1 | 0.30 | 2 | CG |
| Ephemerella inermis | 33 | 10.06 | 4 | SC |
| Nixe criddlei | 14 | 4.14 | 4 | SC |
| Paraleptophlebia debilis | 1 | 0.30 | 1 | CG |
| Ameletus | 1 | 0.30 | 0 | CG |
| TOTAL: EPHEMEROPTERA | 60 | 18.05 | | |
| Sweltsa | 13 | 3.85 | 0 | PR |
| Despaxia augusta | 1 | 0.30 | 0 | SH |
| Amphinemura | 14 | 4.14 | 2 | SH |
| Zapada cinctipes | 5 | 1.48 | 3 | SH |
| Zapada columbiana | 3 | 0.89 | 2 | SH |
| Isoperla (imm.) | 19 | 5.62 | | PR |
| TOTAL: PLECOPTERA | 55 | 16.27 | | |
| Parapsyche elsis | 2 | 0.59 | 0 | CF |
| Lepidostoma | 1 | 0.30 | 1 | SH |
| Ecclisomyia | 2 | 0.59 | 4 | CG |
| TOTAL: TRICHOPTERA | 5 | 1.48 | | |
| Oreodytes | 3 | 0.89 | 5 | PH |
| Hydrobius | 1 | 0.30 | 5 | PR |
| TOTAL: COLEOPTERA | 4 | 1.18 | | |
| Ceratopogonidae | 22 | 7.10 | 6 | PR |
| Dicranota | 4 | 1.18 | 3 | PR |
| Tipula | 3 | 0.89 | 4 | SH |
| TOTAL: DIPTERA | 29 | 9.17 | | |
| Brillia | 2 | 0.59 | 4 | SH |
| Micropsectra | 12 | 3.55 | 4 | CG |
| Orthocladius | 2 | 0.59 | 6 | CG |
| Pagastia | 1 | 0.30 | 1 | CG |
| Parametriocnemus | 2 | 0.59 | 5 | CG |
| Rheocricotopus | 2 | 0.59 | 4 | CG |
| TOTAL: CHIRONOMIDAE | 21 | 6.21 | | |
| GRAND TOTAL | 329 | 100.00 | | |

**Aquatic Macroinvertebrate Data:** Woodson Gulch Reach 2 Site 1

| | |
|---|---|
| Percent of sample used | 53 |
| Subsample size | 329 |
| | |
| Percent EPT | 36 |
| Taxa richness | 32 |
| EPT richness | 15 |
| Biotic Index | 4.82 |
| Percent dominant taxon | 18.64 |
| Percent dominance of five dominant taxa | 62.43 |
| Percent dominance of ten dominant taxa | 83.73 |
| Percent collectors (gatherers plus filterers) | 40.84 |
| Percent scrapers plus shredders | 22.79 |
| Percent Hydropsychinae of Trichoptera | 00 |
| Metals tolerance index | 3.26 |
| Shannon H (log2) | 3.89 |
| Evenness | .78 |
| Brillouin H | 2.55 |
| Simpson D | .10 |
| EPT/Chironomidae | 5.76 |
| CTQa | 65.88 |
| Percent Baetidae of Ephemeroptera | 16 |
| | |
| %Ephemeroptera | 18.06 |
| %Plecoptera | 16.28 |
| %Trichoptera | 1.48 |
| %Coleoptera | 1.19 |
| %Diptera | 9.17 |
| %Chironomidae | 6.21 |
| | |
| Multivoltine | 42.97 |
| Univoltine | 49.48 |
| Semivoltine | 7.54 |

| Functional Feeding Groups | # taxa | % abundance |
|---|---|---|
| Predator | 6 | 33.73 |
| Collector-gatherer | 12 | 29.30 |
| Collector-filterer | 2 | 11.54 |
| Scraper | 2 | 14.20 |
| Shredder | 7 | 8.59 |

| | |
|---|---|
| Estimated total number of organisms | 638 |
| Estimated number collected per foot | unknown |
| Estimated number collected per minute | unknown |

**Aquatic Macroinvertebrate Taxonomic Data**
Spotted Dog Creek: Reach 1, Site 1, Sample 1 August 1998

| **Taxon** | **#** | **%** | **hbi** | **FFG** |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 2 | 1.59 | 4 | PR |
| Oligochaeta: Enchytraeidae | 1 | 0.79 | 10 | CG |
| TOTAL: MISC. TAXA | 3 | 2.38 | | |
| Baetis bicaudatus | 1 | 0.79 | 2 | CG |
| Baetis tricaudatus | 12 | 9.52 | 4 | CG |
| Drunella doddsi | 22 | 17.46 | 1 | SC |
| Drunella spinifera | 6 | 4.76 | 0 | PR |
| Serratella tibialis | 2 | 1.59 | 2 | CG |
| Cinygmula | 7 | 5.56 | 0 | SC |
| Ameletus | 1 | 0.79 | 0 | CG |
| TOTAL: EPHEMEROPTERA | 51 | 40.48 | | |
| Sweltsa | 3 | 2.38 | 0 | PR |
| Amphinemura | 1 | 0.79 | 2 | SH |
| Visoka cataractae | 3 | 2.38 | 0 | SH |
| Doroneuria | 4 | 3.17 | 0 | PR |
| Megarcys | 5 | 3.97 | 1 | PR |
| TOTAL: PLECOPTERA | 16 | 12.70 | | |
| Arctopsyche grandis | 2 | 1.59 | 2 | CF |
| Parapsyche elsis | 1 | 0.79 | 0 | CF |
| Glossosoma | 1 | 0.79 | 0 | SC |
| Dicosmoecus atripes | 1 | 0.79 | 1 | SC |
| Rhyacophila Brunnea Gr. | 1 | 0.79 | 2 | PR |
| Rhyacophila narvae | 2 | 1.59 | 0 | PR |
| TOTAL: TRICHOPTERA | 8 | 6.35 | | |
| Heterlimnius | 40 | 31.75 | 3 | CG |
| TOTAL: COLEOPTERA | 40 | 31.75 | | |
| Hexatoma | 5 | 3.97 | 2 | PR |
| Tipula | 2 | 1.59 | 4 | SH |
| TOTAL: DIPTERA | 7 | 5.56 | | |
| Eukiefferiella Gracei Gr. | 1 | 0.79 | 4 | CG |
| TOTAL: CHIRONOMIDAE | 1 | 0.79 | | |
| GRAND TOTAL | 126 | 100.00 | | |

**Aquatic Macroinvertebrate Taxonomic Data**
Spotted Dog Creek Reach 1, Site 1, Sample 2 August 1998

| Taxon | # | % | hbi | FFG |
|---|---|---|---|---|
| Turbellaria: Polycelis coronata | 10 | 3.27 | 4 | PR |
| Oligochaeta: Lumbriculidae | 2 | 0.65 | 10 | CG |
| TOTAL: MISC. TAXA | 12 | 3.92 | | |
| Baetis bicaudatus | 30 | 9.80 | 2 | CG |
| Drunella coloradensis | 1 | 0.33 | 0 | CG |
| Drunella doddsi | 44 | 14.38 | 1 | SC |
| Drunella spinifera | 14 | 4.58 | 0 | PR |
| Serratella tibialis | 6 | 1.96 | 2 | CG |
| Rhithrogena robusta | 5 | 1.63 | 0 | SC |
| TOTAL: EPHEMEROPTERA | 100 | 32.68 | | |
| Sweltsa | 1 | 0.33 | 0 | PR |
| Paraleuctra | 4 | 1.31 | 0 | SH |
| Amphinemura | 1 | 0.33 | 2 | SH |
| Zapada cinctipes | 4 | 1.31 | 3 | SH |
| Zapada columbiana | 4 | 1.31 | 2 | SH |
| Doroneuria | 14 | 4.58 | 0 | PR |
| Megarcys | 22 | 7.19 | 1 | PR |
| Yoraperla | 2 | 0.65 | 0 | SH |
| TOTAL: PLECOPTERA | 52 | 16.99 | | |
| Parapsyche elsis | 9 | 2.94 | 0 | CF |
| Micrasema | 1 | 0.33 | 1 | SH |
| Glossosoma | 1 | 0.33 | 0 | SC |
| Dolophilodes | 5 | 1.63 | 0 | CF |
| Rhyacophila Betteni Gr. | 2 | 0.65 | 0 | PR |
| Rhyacophila Brunnea Gr. | 10 | 3.27 | 2 | PR |
| Rhyacophila narvae | 6 | 1.96 | 0 | PR |
| Neothremma alicia | 3 | 0.98 | 1 | SC |
| TOTAL: TRICHOPTERA | 37 | 12.09 | | |
| Heterlimnius | 88 | 28.76 | 3 | CG |
| Lara avara | 1 | 0.33 | 1 | SH |
| TOTAL: COLEOPTERA | 89 | 29.08 | | |
| Ceratopogonidae | 2 | 0.65 | 6 | PR |
| Chelifera | 1 | 0.33 | 5 | PR |
| Hexatoma | 4 | 1.31 | 2 | PR |
| TOTAL: DIPTERA | 7 | 2.29 | | |
| Cricotopus Nostococladius | 3 | 0.98 | 6 | SH |
| Diamesa | 1 | 0.33 | 5 | CG |
| Eukiefferiella Gracei Gr. | 3 | 0.98 | 4 | CG |
| Micropsectra | 1 | 0.33 | 4 | CG |
| Tvetenia Bavarica Gr. | 1 | 0.33 | 5 | CG |
| TOTAL: CHIRONOMIDAE | 9 | 2.94 | | |
| GRAND TOTAL | 306 | 100.00 | | |

**Aquatic Macroinvertebrate Data:**

| Spotted Dog Creek Reach 1 Site 1 | Sample 1 | Sample 2 |
|---|---|---|
| Percent of sample used | 100 | 83 |
| Subsample size | 126 | 306 |
| | | |
| Percent EPT | 60 | 62 |
| Taxa richness | 24 | 34 |
| EPT richness | 18 | 22 |
| Biotic Index | 1.98 | 1.89 |
| Percent dominant taxon | 31.75 | 28.76 |
| Percent dominance of five dominant taxa | 69.05 | 64.71 |
| Percent dominance of ten dominant taxa | 84.92 | 80.73 |
| Percent collectors (gatherers plus filterers) | 48.40 | 48.04 |
| Percent scrapers plus shredders | 29.36 | 23.87 |
| Percent Hydropsychinae of Trichoptera | 00 | 00 |
| Metals tolerance index | 2.03 | 2.08 |
| Shannon H (log2) | 3.48 | 3.80 |
| Evenness | .76 | .75 |
| Brillouin H | 2.17 | 2.47 |
| Simpson D | .15 | .13 |
| EPT/Chironomidae | 75 | 21 |
| CTQa | 40.88 | 48.24 |
| Percent Baetidae of Ephemeroptera | 25 | 30 |
| | | |
| %Ephemeroptera | 40.47 | 32.68 |
| %Plecoptera | 12.69 | 17.01 |
| %Trichoptera | 6.34 | 12.09 |
| %Coleoptera | 31.75 | 29.09 |
| %Diptera | 5.56 | 2.29 |
| %Chironomidae | .79 | 2.95 |
| | | |
| Multivoltine | 9.92 | 12.83 |
| Univoltine | 50.40 | 47.30 |
| Semivoltine | 39.68 | 39.87 |

| Functional Feeding Groups | # taxa | % abundance | # taxa | % abundance |
|---|---|---|---|---|
| Predator | 8 | 22.22 | 11 | 28.12 |
| Collector-gatherer | 7 | 46.02 | 9 | 43.47 |
| Collector-filterer | 2 | 2.38 | 2 | 4.57 |
| Scraper | 4 | 24.60 | 4 | 17.32 |
| Shredder | 3 | 4.76 | 8 | 6.55 |
| | | | | |
| Estimated total number of organisms | | 126 | | 369 |
| Estimated number collected per foot | | 8 | | unknown |
| Estimated number collected per minute | | 126 | | unknown |